INSTRUCTION MANUAL

B+K PRECISION 2845

Autoranging DIGITAL MULTIMETER

B+K PRECISION DYNASCAN CORPORATION

TEST INSTRUMENT SAFETY

WARNING

Normal use of this instrument exposes you to a certain amount of danger from electrical shock because it is often used to measure high voltage, or to make other measurements in equipment that contains high voltage. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltage poses an even greater threat because it can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high voltage circuits. Discharge high voltages capacitors after removing power.

2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.

3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet. Where insulated floor surface is not available, wear heavy gloves.

4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a ground return path.

5. When using the test probe, touch only the insulated portion. Never touch the exposed tip portion.

(Continued on inside rear cover)

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DEFINITIONS OF SYMBOLS APPEARING ON METER

Read operating instructions.

High voltage terminals; 1000 volts or more may be present if connected to high voltage.

500V Common input terminal. Connect to earth ground or point not more than 500 volts from earth ground.

Input terminal for dc (−), ac (~), or ohms (Ω).

1000 VDC
750 VAC
2A Maximum input rating of Ω terminal with respect to common input terminal.

INTRODUCTION

The B & K-Precision Model 2845 Autoranging Digital Multimeter is a high-accuracy instrument for measuring dc and ac voltage, dc and ac current, and resistance. The advanced design incorporates a microcomputer and features high performance plus many time-saving and convenience features.

Among the performance features are 0.1% accuracy, 1mV/1Ω/1μA resolution, extensive overload protection, long battery life, and rf shielding. The major convenience and time-saving features include microcomputer controlled autoranging with "Auto Skip", autopolarity, autozero, continuity buzzer, range lock, overrange indication with range identifier, pushbutton operation with mode identifier, low battery indication, simplified (thus less error prone) operation, and safety design. All these features are fully described in the FEATURES portion of this manual.

High performance and convenience at moderate cost makes the Model 2845 a great value for field service, test bench, laboratory, classroom, and hobbyist applications. To gain the most value from the instrument, we recommend that you study the entire manual to fully understand all the capabilities of the instrument, and to familiarize yourself with all operating techniques.

FEATURES

AUTORANGING — Microcomputer automatically selects range with greatest resolution for voltage, current, and resistance measurements.

AUTO SKIP — "Auto Skip" feature immediately skips to 200V range if initial input is greater than about 25 volts; faster settling time because autoranging circuits never step through more than two voltage ranges.

RANGE LOCK — User can defeat autoranging and lock onto any range in VOLTS, OHMS, or MILLIAMPS function. Pushbutton selectable. Fastest method for taking a series of

similar measurements because no range stepping time is involved. Range lock memory keeps meter locked onto same range if switched to a different function. For example, 20V range becomes 20KΩ or 20mA range. (20MΩ range reverts to 1000 V or 2000 mA range if VOLTS or MILLIAMPS function is selected.)

OVERRANGE INDICATION WITH "RANGE IDENTIFIER"

In range lock mode, overrange condition is indicated by blank digits (except first digit "1" displayed continuously for reference) and flashing decimal points. "Range Identifier" feature identifies range you are locked onto; decimal point for that range does not flash.

CONTINUITY BUZZER

Continuous audible tone when resistance measures 179 ohms or less. Buzzer permits eyes to stay on point of measurement without diverting back to the meter. Resistance path over 179 ohms will not give false continuity indication. Continuous tone aids in isolating intermittents. User can select or disable this feature whenever desired.

3-1/2 DIGIT LCD DISPLAY

Large, easy-to-read 0.5" high-contrast liquid crystal display gives digital readings from 000 to 1999. Integral decimal points, polarity sign, KΩ and MΩ indicator, and LO BAT indicator, all automatically controlled.

AUTO POLARITY

Minus sign automatically displayed for negative polarity dc voltage and current, plus sign implied for positive polarity.

AUTO ZERO

Design eliminates need for zero adjustment, simplifies operation and reduces error.

HIGH ACCURACY

Basic accuracy is 0.1% of reading on all dc voltage ranges.

21 RANGES

Five resistance ranges measure from .001 KΩ to 19.99 MΩ. Four dc voltage ranges measure from

FEATURES (cont.)

	.001 V to 1000 V. Four ac voltage ranges measure from .001 V to 750 V rms. Four dc and four ac current ranges measure from .001 mA to 1999 mA. All ranges automatically selected.
HIGH RESOLUTION	3-1/2 digit display gives resolution of 1 mV, 1μA, and 1Ω on most sensitive range.
WIDE AC FREQUENCY RESPONSE	Permits reliable measurements in audio and tone circuits (using sine wave signals) as well as 50/60 Hz line frequency circuits.
RF SHIELDING	Internal shielding retains accuracy in the presence of rf fields.
OVERLOAD PROTECTION	Extensive overload protection, even against "mistakes" such as attemping resistance measurements with voltage applied, or current measurements in parallel with load. Except for severe overloads, an easily replaced blown fuse will be the only damage.
SAFETY DESIGN	"Fingerproof" jacks and recessed, non-exposed plugs.
LONG BATTERY LIFE	Powered from single 9-volt transistor battery which typically gives at least 100 hours operation from alkaline battery, which may be several months of intermittent use.
LOW BATTERY INDICATION	Integral LO BAT indicator in LCD display illuminates when battery nears end of useful life (20% remaining). Sufficient reserve to allow continued use until convenient to replace battery.
PUSHBUTTON CONVENIENCE WITH "MODE IDENTIFIER"	All functions and modes selected by pushbutton switches on side of case. Instrument can be held and operated with one hand while holding test probe in other hand. "Mode Identifier" feature visually highlights which function and mode is selected. High visibility color tabs on pushbutton switches show through windows on front panel; you can tell at a glance which pushbuttons are engaged.

UNCOMPLICATED A single pair of test jacks is used for all type measurements. This, plus autoranging, autopolarity, autozero, and uncluttered styling make this instrument simple and easy to use; reduces set-up time and reading errors. Design incorporates microcomputer and integrated circuits to minimize number of components for reliability and simplified service. Uses highly reliable sealed reed relays for range switching. Also, there are only two calibration adjustments.

FIELD USE HIGHLIGHTS Compact, rugged design and operational features already described such as autoranging, continuity buzzer, ease of use, and long battery life make the Model 2845 very desirable for field service applications. An optional accessory carrying case is available for added protection and carrying convenience in field use.

BENCH USE HIGHLIGHTS Accuracy and resolution meet all but the most demanding bench and laboratory requirements. Convenience and ease of use features save time and reduces errors under continuous use. Built-in tilt stand for bench use. An optional accessory battery eliminator adapts for operation from ac power.

FULL LINE OF ACCESSORIES Supplied with safety designed test leads, spare fuses, and instruction manual. A complete line of optional accessories is available (page 8) to further expand measurement capabilities.

SPECIFICATIONS

SPECIAL FEATURES

Autoranging	Microcomputer controlled.
Auto Skip	For initial input greater than approximately 25 volts, unit immediately jumps to 200 V range. Eliminates stepping through two ranges and permits settling time of less than 1 second for 200 V range.
Range Lock	Enables user to lock into any range of any function. In range lock, overrange condition is indicated by blank digits (except continuous display of first digit "1" for reference) and flashing decimal points; decimal point for range that meter is locked onto does not flash.
Continuity Buzzer	Audible tone sounds continuously when resistance measures 179 ohms or less. User selectable and can be defeated at any time.
Safety Features	Fingers will not fit into test lead or battery eliminator jacks, mating plugs use recessed, non-exposed contacts. Warning and caution labels on front and rear case.

DC VOLTAGE

Ranges	± 2V, 20V, 200V, 1000V range, automatically selected.
Accuracy	± 0.1% of reading ± 1 LSD on all ranges.
Polarity Indication	Automatic; minus sign shown, plus sign implied.
Input Impedance	10 megohms.
Circuit Protection	1000 volts dc or dc + ac peak. Protected by metal oxide varistors and fuse.

AC VOLTAGE

(average responding circuitry calibrated to read rms value of pure sine wave)

Ranges	2V, 20V, 200V, 1000V (input limited to 750 volts rms), automatically selected.

Accuracy

Range	50-200 Hz	200 Hz-1 kHz	1 kHz-5 kHz
2V, 20V,	±0.5% ±3 LSD	±2% ±3 LSD	±1dB
200V, 1000V	±1% ±3 LSD	-	-

Input Impedance	10 megohms.
Circuit Protection	750 volts ac rms, 1000 volts dc + ac peak. Protected by metal oxide varistors and fuse.

DC CURRENT

Ranges	±2 mA, 20 mA, 200 mA, 2000 mA, automatically selected.
Accuracy	±0.75% of reading ±1 LSD on all ranges.
Polarity Indication	Automatic; minus sign displayed, plus sign implied.
Voltage Burden	200 mV at full scale on 2 mA, 20 mA, and 200 mA ranges, 600 mV typical at full scale on 2000 mA range; measured across input terminals.
Circuit Protection	2 amp fuse and diodes.

AC CURRENT

Ranges	2 mA, 20 mA, 200 mA, 2000 mA automatically selected.
Accuracy	±1% of reading ±3 LSD, 50 Hz to 1 kHz.
Voltage Burden	200 mV at full scale on 2 mA, 20 mA, and 200 mA ranges, 600 mV typical at full scale on 2000 mA range; measured across input terminals.
Circuit Protection	2 amp fuse and diodes.

RESISTANCE

Ranges	2KΩ, 20KΩ, 200KΩ, 2000KΩ, 20MΩ, automatically selected with automatic KΩ or MΩ indicator.

LSD = least significant digit

SPECIFICATIONS (cont.)

Accuracy	±0.3% of reading ±1 LSD on 2 KΩ to 2000 KΩ ranges. ±0.6% of reading ±1 LSD on 20 MΩ range.
Polarity	Red jack positive on all ranges.
Circuit Protection	+1000 to −450 VDC or 300 VAC.

GENERAL

Display	3-1/2 digit 0.5″ high-contrast LCD.
Operating Environment	0° to 55° C (18° to 28° for stated accuracy), 0 to 80% humidity.
Power Source	One 9-volt tranistor battery (NEDA 1604 or equivalent), or optional BE-16 battery eliminator.
Battery Life	100 hours typical with alkaline battery. Automatic low battery indicator.
Dimensions	3-3/4 x 6-3/4 x 1-1/4″ (95 x 175 x 30mm)
Weight	1 pound (.45 kg).
Accessories Included	Built-in tilt stand, two safety test leads, spare fuses, instruction manual.

OPTIONAL ACCESSORIES

LC-45 CARRYING CASE

Zippered leatherette case with belt loop provides extra protection and convenience for field use. Includes storage space for probes.

BE-16 BATTERY ELIMINATOR

Permits operation from 120-volt, 60 Hz ac power, grounded outlet.

WARNING

Do not substitute a calculator type battery eliminator for the BE-16. Calculator type units do not provide the protection required for floating the common test lead up to 500 volts dc. A shock hazard and serious internal damage may result.

PR-21 ISOLATION/DIRECT PROBE

Has switchable 100 KΩ resistor to aid in measuring dc in rf circuits.

PR-23 RF DETECTOR PROBE

Permits measurement of rf signals from 15 kHz to 250 MHz.

PR-28 HIGH VOLTAGE PROBE

Extends maximum voltage capability to 40 kVDC, 20 kVAC at 60 Hz. 1000:1 divider lets meter reading in volts represent circuit voltage in kV. Input impedance is 600 MΩ.

ES-28 10-AMPERE SHUNT

Extends maximum current capability to 10 amperes. 1000:1 divider lets meter reading in milliamps represent circuit current in amps.

TP-28 TEMPERATURE PROBE

Converts the 2845 into a digital thermometer capable of −50° to +150° C (−58° to +302° F) measurements. Switch selectable °C or °F scales. Probe measures surface temperature of even small components, ambient air temperature at probe tip, or liquid temperatures by immersion of tip.

CONTROLS AND INDICATORS
(Refer to Fig. 1)

Power Switch. Turns unit ON and OFF.

Function Switches. Select the type of measurement to be performed; VOLTS, OHMS, or MILLIAMPS. Three interlocking pushbutton switches, pressing one releases previous selection.

DC/AC Switch. Selects DC or AC mode for VOLTS and MILLIAMPS functions. Alternate action pushbutton

switch; push to latch in AC position, push again to release to DC position.

AUTO/LOCK Switch. Selects AUTO (autoranging) or LOCK (range lock) mode. Alternate action pushbutton switch; push to latch in LOCK position, push again to release to AUTO position. Continuity buzzer is enabled by shorting test leads together in OHMS function, then selecting LOCK mode.

"Mode Identifier" Windows. Color tabs on pushbutton switches show through these windows to identify which function and mode are selected. VOLTS, OHMS or MILLIAMPS window shows white when corresponding pushbutton is engaged. AUTO/LOCK and DC/AC windows show white for AUTO and DC modes (pushbutton released) and red for LOCK and AC modes (pushbutton engaged).

WARNING

High voltage up to 1000 volts or more may be present on the test leads and test lead jacks when the test leads are connected to high voltage.

⏚ **Jack (white).** Input for black test lead. Common or reference side for all functions. The test lead connected to this jack is normally applied to the point nearer signal or earth ground. Maximum input rating 500 volts with respect to ground.

Ω̄ **Jack (red).** Input jack for red test lead. "Hot" or "high" side for all functions. The test lead connected to this jack is normally applied to the point more removed from signal or earth ground. Positive polarity for resistance measurements. Maximum input rating 1000 volts dc or 750 volts ac with respect to common jack, 2 amperes current.

Display. 3-1/2 digit LCD readout. Indicates numerical value of all measurements (maximum reading 1999). Automatic decimal point placement. Indicate overrange condition by blank numerals (except first digit "1" displayed continuously) and flashing decimal points. The minus sign, KΩ, MΩ, and LO BAT indicators are also an integral part of the display:

Minus (−) Sign. Automatically displayed for negative polarity dc voltage or current. The plus sign is implied and not displayed. Polarity is that of hot input jack with respect to common input jack.

LO BAT Indicator. Automatically displayed when battery nears discharge; about 20% of useful battery life remains. Unit may be

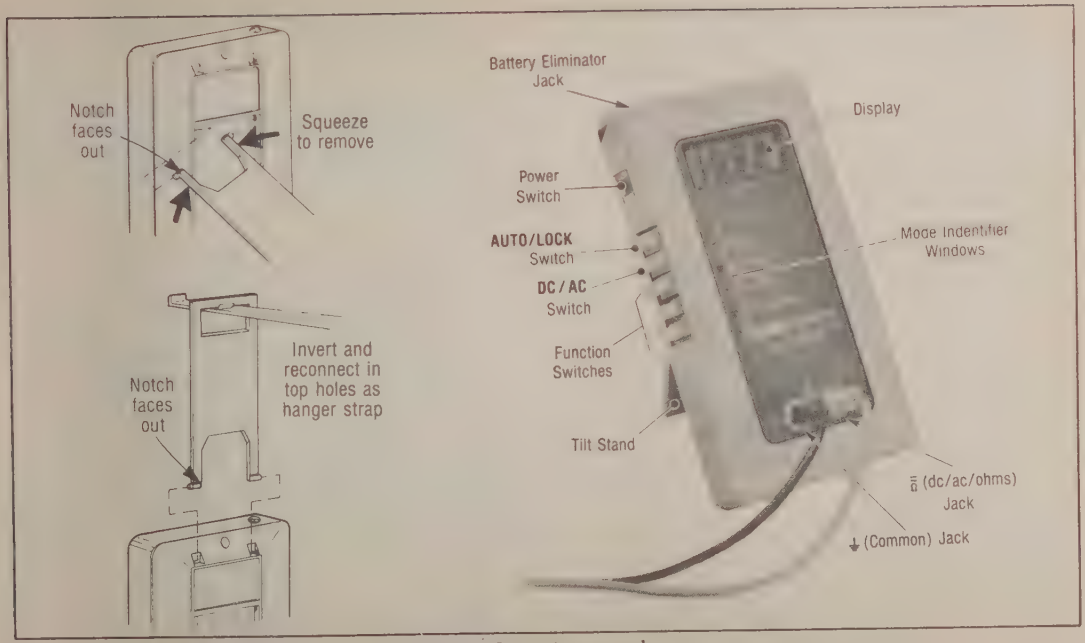

Fig. 1. Operating controls.

operated after LO BAT indication appears until battery discharges to 6.5 volts before accuracy of measurements is affected.

KΩ Indicator. Automatically displayed in OHMS function on all KΩ ranges.

MΩ Indicator. Automatically displayed in OHMS function on 20 MΩ range.

Battery Eliminator Jack. Connector for Model BE-16 accessory.

Tilt Stand. Folds out from rear case to provide convenient viewing angle for bench use. Also converts to use as hanger strap as shown in Fig. 1.

OPERATING INSTRUCTIONS

WARNING

There is always a certain amount of danger from electrical shock when working with electrical equipment. Observe the "Test Instrument Safety" practices listed on the inside covers of this manual to reduce the risk of electrical shock.

OPERATION FROM BATTERY

The Model 2845 is shipped without a battery so that a fresh battery can be installed when you are ready to use the unit. Select and install a standard 9-volt transistor battery as described in the OPERATOR MAINTENANCE section of this manual. As with other battery powered equipment, the meter should be turned off except during actual measurements to get maximum battery life.

When the LO BAT indication appears in the display, the battery is nearing discharge. Actually, there is about 20% of useful battery life remaining when the LO BAT indication first appears. The battery may be replaced at the first convenient opportunity, or for maximum battery life, operation may be continued until battery voltage drops to 6.5 volts. To assure accuracy, battery voltage must not drop below 6.5 volts. This meter can measure its own battery voltage, which should be done periodically if the LO BAT indication appears. The special battery voltage measurement procedure and the battery replacement pro-

cedure are given in the OPERATOR MAINTENANCE section of this manual.

OPERATION FROM AC POWER

This meter may be operated from 120-volt, 60 Hz ac power by using the Model BE-16 Battery Eliminator (optional accessory), with or without a battery installed in the meter. The battery is disconnected when the battery eliminator plug is inserted into the mating jack on the meter.

WARNING

Do not substitute a calculator type battery eliminator for the BE-16. Calculator type units do not provide the protection necessary for floating the common test lead up to 500 volts dc. A shock hazard and serious internal damage may result.

Be sure the battery eliminator plug is firmly inserted into the jack of the 2845 Digital Multimeter, then connect to a 3-wire ac outlet. The test leads of the Model 2845 are still isolated from the ac line to permit "floating" measurements; that is, measurements with a reference other than earth ground. Of course, common mode interference on ac measurements is minimum when the common test lead is connected to a point at or near earth ground potential.

AUTORANGING MODE

The autoranging mode is the simplest to use because range selection is automatic. All measurements may be performed in this mode if desired.

Preliminary

1. Connect the black test lead to the ⏚ (common) input jack, and the red test lead to the Ω (hot) input jack.
2. Set the power switch ON.
3. Select the AUTO mode with the AUTO/LOCK switch (pushbutton released and white showing through corresponding mode identifier window).
4. The meter is ready for making measurements in either the VOLTS, OHMS, or MILLIAMPS function.

WARNING

Do not attempt to measure voltages greater than 1000 volts dc, 750 volts ac rms, or 1000 volts dc + ac peak. Higher voltages exceed the rating of the meter and test leads. Such voltages can easily "jump" or arc and are therefore dangerous. Although this meter contains extensive overvoltage protection, extreme overvoltage could cause arcing or insulation breakdown, resulting in electrical shock from touching the meter or test leads, and possible damage to the meter.

DC Voltage Measurements

1. Select VOLTS function (VOLTS pushbutton engaged and white showing through corresponding identifier window).

2. Select DC mode with DC/AC switch (pushbutton released and white showing through corresponding mode identifier window).

3. Connect black test lead to point of reference in circuit where measurement is to be made (not to exceed 500 volts dc + ac peak with respect to earth ground or chassis of equipment under test).

4. Connect red test lead to point of measurement (not to exceed 1000 volts dc + ac peak with respect to point of reference).

5. Read value in volts from display. If minus (–) sign appears in display, voltage at red input jack is negative with respect to black input jack, otherwise it is positive.

AC Voltage Measurement

1. Select VOLTS function.

2. Select AC mode with DC/AC switch (pushbutton engaged and red showing through mode identifier window).

3. Connect black test lead to point of reference in circuit where measurement is to be made (not to exceed 500 volts dc + ac peak with respect to earth ground or chassis of equipment under test).

4. Connect red test lead to point of measurement (not to exceed 750 volts ac rms or 1000 volts dc + peak with respect to point of reference).

5. Read value in volts from display.

Resistance Measurement

CAUTION

Do not attempt to measure resistance in a circuit in which power is applied. Remove power and discharge capacitors before attempting resistance measurements.

1. Select the OHMS function (OHMS pushbutton engaged and white showing through corresponding identifier window).

2. DC/AC switch may be in either position.

3. Connect black test lead to one side of circuit where measurement is to be made, connect red test lead to other side.

4. Read value of resistance from display in KΩ or MΩ, as indicated in the display.

The meter applies a low voltage across the resistance being measured. Table 1 lists the typical open-circuit voltage for each range of the OHMS function. Voltage is that obtained by measurement with a standard voltmeter having 10-megohm input impedance. The red input jack is the positive polarity of this voltage. Polarity is usually unimportant except in semiconductor testing. Semiconductor testing is more predictable and results easier to interpret in the range lock mode; therefore, the procedures are located in that portion of the OPERATING INSTRUCTIONS.

RANGE	OPEN CIRCUIT VOLTAGE
2 KΩ	.985 V
20 KΩ	.985 V
200 KΩ	.975 V
2000 KΩ	.900 V
20 MΩ	.575 V

Table 1. Typical open-circuit voltage in OHMS function.

DC Current Measurement

CAUTION

For current measurements, the meter must be connected in *series* with the load. When the MILLIAMPS function is selected, the meter presents a very low impedance, approaching that of a short. If the meter is incorrectly connected in parallel with the load, the load is bypassed by a virtual short. Doing so may either blow protective overload fuse F2 or damage the equipment under test.

1. Select the MILLIAMPS function (MILLIAMPS pushbutton engaged and white showing through corresponding identifier window).

2. Select DC mode with DC/AC switch.

3. Remove power from circuit and open normal circuit path where measurement is to be taken. Open the circuit at a point that does not exceed 500 volts dc + ac peak from earth ground or the chassis of the equipment under test.

4. Connect the test leads to the two points where the circuit was opened.

   a. If the meter is between the load and the positive side of the power source, connect the black test lead to the load and the red test lead to the power source.

   b. If the meter is between the load and the negative side of the power source, connect the red test lead to the load and the black test lead to the power source.

5. Apply power and read the value in milliamps from the display. If a minus (–) sign is displayed, the polarity at the red test lead is negative with respect to the black test lead, otherwise it is positive.

AC Current Measurement

CAUTION

Observe the same precautions as listed for dc current measurement.

1. Select the MILLIAMPS function.
2. Select the AC mode with the DC/AC switch.
3. Remove power from circuit and open the normal circuit path where measurement is to be taken, at a point that does not exceed 500 volts dc + ac peak with respect to earth ground or the chassis of the equipment under test.
4. Connect the test leads to the two points where the circuit was opened.
5. Apply power and read the value in milliamps from the display.

Considerations

1. For all types of measurements, the display is changing until the autoranging circuits have stepped to the correct range and settled. Range stepping can be observed as the displayed decimal point shifts position.
2. Autoranging circuits up-range when the count is greater than 1999, and down-range when the count is 179 or less (or lowest range is reached). This automatically gives the highest resolution while it prevents range jumping if a reading varies up to 10% about a range limit.
3. When the meter is first turned on, it always starts on range 1 (2V/2KΩ/2mA range).
   a. In the VOLTS and MILLIAMPS functions, and with the test leads not connected to a circuit, the meter remains on range 1 and gives a reading of .000. When the test leads are applied to the point of measurement, the meter up-ranges to the correct range and displays the reading. In the VOLTS function, the "auto skip" feature instantly up-ranges the meter to range 3 (200 V range) if the initial value is greater than about 25 volts. When the test leads are removed from the point of measurement, the meter again down-ranges one range at at time until it reaches range 1.

b. In the OHMS function, and with the test leads open, the meter up-ranges one range at a time to range 5 (20 MΩ range). The MΩ indicator is displayed and the display gives an "overrange" indication. That is, the first digit "1" is continuously displayed, the last 3 digits are blank, the normal decimal point for the 20 MΩ range is continuously displayed, and the other two decimal points flash on and off. When the test leads are connected across a resistance, the meter down-ranges to the correct range and displays a reading. When the test leads are removed from the resistance, the meter again up-ranges to range 5. If the test leads are shorted together, the meter down-ranges one range at a time until it reaches range 1, then gives a reading of .000 KΩ.

c. In any function, the meter can be immediately reset to range 1 by momentarily turning it off, then on. This technique may be used, for example, to obtain maximum resolution for resistance measurements when readings are between 180 and 199 (regardless of decimal point placement). With this technique, range stepping begins at range 1 and up-ranges instead of at range 5 and down-ranging.

4. In the VOLTS function, the maximum input voltage is limited to 1000 volts by MOV's (metal-oxide varistors). If voltage greater than 1000 volts is accidentally applied, the MOV's begin to conduct and load the applied voltage source. If the applied voltage is from a high energy source, overvoltage protection fuse F1 will blow. When F1 is blown, a zero reading will result for all subsequent voltage measurements. Random, unstable readings will also result on the 20 MΩ resistance range, but this symptom is sometimes unnoticed since all other resistance ranges continue to operate normally. Replace the fuse as instructed in the OPERATOR MAINTENANCE section. Take care not to repeat the conditions which caused the fuse to blow.

5. In the MILLIAMPS function, the maximum input current is limited to 2000 mA. If a greater current is accidentally applied, overcurrent protection fuse F2 will blow. When F2 is blown, a zero reading will result for all subsequent current measurements; voltage and resistance functions are unaffected. Replace the fuse as instructed in the OPERATOR MAINTENANACE section. Avoid the condition which caused the fuse to blow. Applying a voltage to the unit while in the MILLIAMPS function will usually blow this fuse.

6. In the OHMS function, the meter is protected against damage if voltage is accidentally applied across the input jacks (for example, you forget to remove power before making a resistance check). Protection is limited to +1000 volts, −450 volts and 300 volts ac rms; greater voltage may damage the meter. Within these limits, protection is continuous (that is, not restricted to momentary or brief period). Normal resistance measurements may resume within 5 seconds after the voltage is removed.

RANGE LOCK MODE

The fastest method of making a series of similar measurements is with the range lock mode. In this mode, the meter remains locked onto a range when the test leads are removed from a point of measurement. When the next measurement is taken, the meter is already on the correct range and the time normally required for autoranging is eliminated.

Normal Procedure

1. Make the first measurement of the series in the AUTO mode as previously described. This applies for DC and AC measurements in VOLTS, OHMS, or MILLIAMPS functions.

2. Before removing the test leads from the point of measurement, select the LOCK mode (AUTO/LOCK pushbutton engaged and red showing through corresponding mode identifier window).

3. Make the remainder of the measurements in the series.

In the LOCK mode, the meter will display a reading for all measurements that would appear on a lower range if in the AUTO mode, but with less resolution. That is, the last digit(s) of the reading is eliminated. When high resolution is not required, this reading is adequate. For any reading less than 180, greater resolution is possible by returning to the AUTO mode (except when locked onto the lowest range, of course).

If a measurement is too high for the range the meter is locked onto, an overrange indication is given. The overrange indication also shows which range you are locked onto. Fig. 2 and 3 illustrate the overrange indications. Return to the AUTO mode and allow the meter to uprange and give a reading. Table 2 summarizes meter characteristics for each range and function.

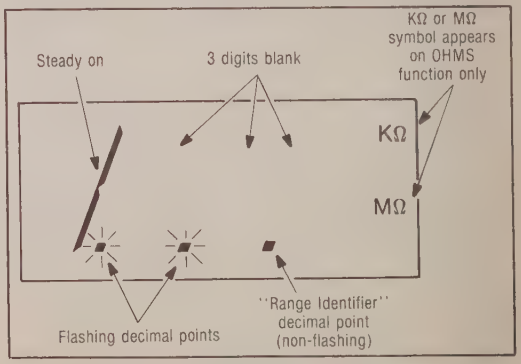

Fig. 2. Typical overrange indication.

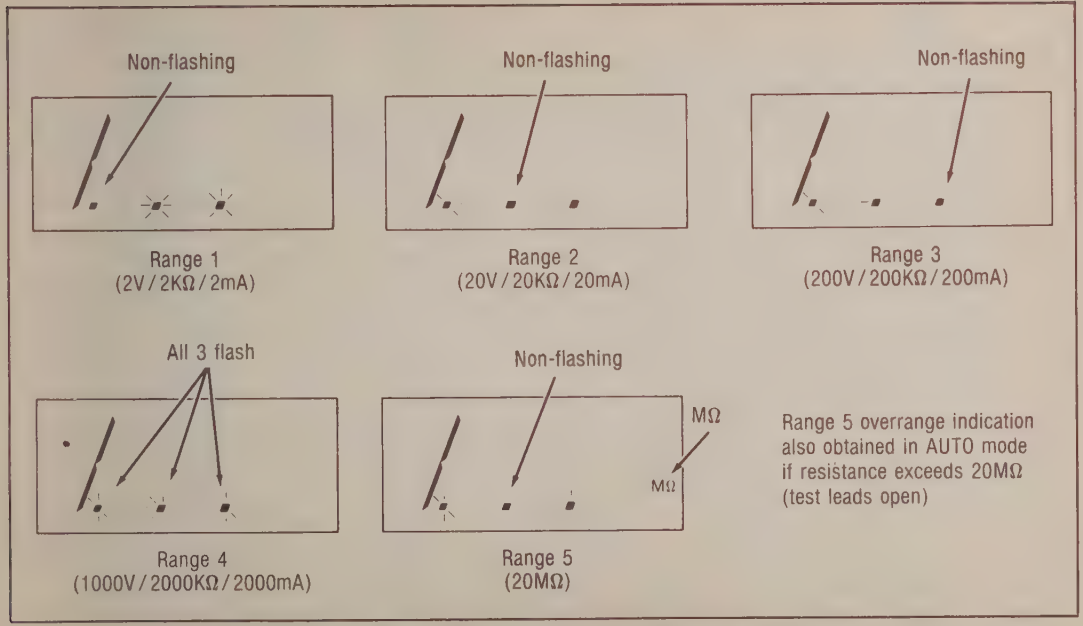

Fig. 3. "Range Identifier" overrange indications for range lock mode.

RANGE	FUNCTION	READINGS ARE IN	MEASURES	FULL SCALE	RESOLUTION **	DECIMAL POINT
1	VOLTS (DC)	volts	0-2 V	1.999	1 mV	X.XXX
2			0-20 V	19.99	10 mV	XX.XX
3			0-200 V	199.9	100 mV	XXX.X
4			0-1000 V*	1000 *	1 V	XXXX.
1	VOLTS (AC)	volts	0-2 V	1.999	1 mV	X.XXX
2			0-20 V	19.99	10 mV	XX.XX
3			0-200 V	199.9	100 mV	XXX.X
4			0-750 V*	750 *	1 V	XXXX.
1	MILLIAMPS (DC or AC)	mA	0-2 mA	1.999	1 μA	X.XXX
2			0-20 mA	19.99	10 μA	XX.XX
3			0-200 mA	199.9	100 μA	XXX.X
4			0-2 A	1999	1 mA	XXXX.
1	OHMS	kΩ	0-2 kΩ	1.999	1 Ω	X.XXX
2			0-20 kΩ	19.99	10 Ω	XX.XX
3			0-200 kΩ	199.9	100 Ω	XXX.X
4			0-2 MΩ	1999	1 kΩ	XXXX.
5		MΩ	0-20 M	19.99	10 kΩ	XX.XX

* Do not exceed 1000 volts dc + ac peak.

** Resolution indicates the change in the measured value that is required to shift the least significant digit one count.

Table 2. Summary of meter characteristics for each range.

Alternate Procedure

This procedure differs from the normal procedure only in that it permits you to lock onto any specific range before taking any measurements, if desired.

1. Starting in the AUTO mode, select the OHMS function and leave the test leads open. The meter will up-range to range 5 and give an overrange indication.

2. Now short the test leads together and watch the display as the meter automatically down-ranges, one range at a time, toward range 1. The decimal point shows you which range is selected at any given time (although the rest of the display may be blank during the autoranging process, the decimal point is displayed in its normal position for that range). Refer to Table 2.

3. Press the AUTO/LOCK pushbutton (to LOCK position) as the meter steps to the desired range. This must be done quickly, since each range step requires only about 1/3 of a second.

4. If resistance measurements are to be performed, leave the OHMS function selected. If voltage or current measurements are to be performed, select the VOLTS or MILLIAMPS function, as appropriate. The meter stays locked onto the same range regardless of function. That is, you can lock the meter onto range 3 in the OHMS function, and it will remain on range 3 if another function is selected. Although there are five resistance ranges versus four voltage and current ranges, the meter stays locked onto the highest range if initially locked onto range 5. That is, if locked onto range 5 in the OHMS function, the meter reverts to range 4 if the VOLTS or MILLIAMPS function is selected, but will not return to range 5 if the OHMS function is re-selected.

The same results can be obtained by starting in range 1 and letting the meter up-range in the AUTO mode until the desired range is reached. This can be achieved in any of the following manners:

a. With OHMS function selected, short test leads together and obtain .000 KΩ reading (range 1). When test leads are opened, meter will start to up-range.

b. With OHMS function selected and test leads open, momentarily turn off unit. When unit is turned on, it always starts in range 1 and begins to up-range.

c. With VOLTS and MILLIAMPS function initially selected, meter will display .000 reading (range 1). If test leads are open, meter will start to up-range when OHMS function is selected.

Semiconductor Testing

Diodes and transistors may be checked by measuring front-to-back ratio in the OHMS function. Results are more predictable and easier to interpret if performed in the range lock mode. Use the 20 MΩ range for checking silicon transistors, the 200 KΩ range for silicon diodes, and the 20 KΩ range for germanium transistors or diodes. If you do not know whether a transistor or diode is silicon or germanium, use both ranges for that type device. If it is good, it will correspond to the reading in Table 3 for a good device in one of the ranges. The type of device will also be determined by the measurement.

It is usually recommended that the semiconductor be removed from its circuit for testing. Shunt resistance can have a large effect upon the readings obtained, which may cause the results to be unreliable and inconclusive.

1. Select the OHMS function and lock the meter onto the appropriate range (see Table 3).

2. Connect the test leads to the device (diode, base-emitter junction, or base-collector junction) and take a reading.

3. Reverse the test lead connections and take another reading.

4. Table 3 summarizes test results.

RANGE	TEST RESULTS	CONDITION
20 MΩ	4.00 to 7.00 MΩ reading in one direction. Overrange in other direction.	Junction probably good silicon transistor.
200 KΩ	40.0 to 70.0 KΩ reading in one direction. Overrange in other direction.	Junction probably good, silicon diode.
20 KΩ	1.00 to 3.00 KΩ reading in one direction. Overrange in other direction.	Junction probably good, germanium transistor or diode.
	Zero or low resistance in both directions.	Junction shorted or leaky.
	Overrange in both directions.	Junction open.

Table 3. Front-to-back ratio testing of semiconductors.

The elements of a good semiconductor can also be identified from this test. With the test leads applied in the direction that gives the lower resistance reading (forward direction), elements can be identified as follows:

a. For diodes, the cathode is the end where the black test lead is applied and the anode is the end where the red test lead is applied.

b. For npn transistors, the base is the pin where the red test lead is applied.

c. For pnp transistors, the base is the pin where the black test lead is applied.

d. If the base, emitter, and collector pins are known, you can determine whether a transistor is a pnp or npn type. If the forward direction occurs when the red test lead is applied to the base, the device is an npn type. The forward direction of pnp type devices occurs when the black test lead is applied to the base.

CONTINUITY BUZZER

An audible tone accompanies resistance readings of 179 ohms or less whenever the continuity buzzer is enabled. This means that you do not have to divert your vision from the point of measurement back to the meter to confirm continuity. This feature is very convenient in most situations where a series of continuity checks is to be performed.

Procedure

1. Starting in the AUTO mode, select the OHMS function.
2. Short the test leads together until the meter down-ranges to range 1 and gives a .000 KΩ reading.
3. Select the LOCK mode.
4. The continuity buzzer is now enabled and will sound for any subsequent reading of 179 ohms or less.
5. Return to the AUTO mode to disable the continutiy buzzer.

Considerations

1. The continuity buzzer is enabled only in the range lock mode when locked onto range 1 and with the OHMS function selected.
2. There is a slight delay from the time the test leads are touched to the point of measurement until the buzzer sounds (about 1/3 second). This is identical to the delay that occurs before a reading appears in the visual display.
3. The low continuity indication threshold of 179 ohms makes false continuity indication unlikely. Parallel or "sneak" paths seldom consist of less than 180 ohms resistance.

4. The buzzer sounds continuously as long as the test leads are applied to the point of measurement and resistance remains below 180 ohms. This design has the ability to detect intermittent breaks in continuity. If interruptions of the sound are noted when a cable is wiggled, for example, intermittent continuity is indicated.

5. Momentary interruptions of continuity are "stretched", and thus made more noticeable, in the audible output. A short interruption of continuity causes an almost immediate interruption of the sound. However, when continuity is restored, the 1/3 second delay mentioned in step 2 occurs before the sound resumes.

OPERATOR MAINTENANCE

WARNING

To prevent electric shock, disconnect test leads from equipment under test before replacing battery or fuses, or removing the rear case from the instrument for any reason. Do not operate the instrument unless the rear case in in place and fully closed.

MEASURING BATTERY VOLTAGE

The LO BAT indication appears whenever battery voltage is below approximately 7.4 volts. Meter accuracy is retained down to 6.5 volts. If the LO BAT indication appears, be sure battery voltage exceeds 6.50 volts before making any measurements. This meter can measure its own battery voltage without removing the case by using the following procedure (refer to Fig. 4):

CAUTION

Use the $\overline{\Omega}$ (hot) test lead *only*. The meter will be damaged if the $\perp$ (common) test lead is used.

1. Select the VOLTS function, DC mode, and AUTO mode.

2. Remove the black test lead from the meter.

3. Using the Ω test lead only, first touch the probe tip to the center pin, then to the outer contact of the battery eliminator jack. Two readings will be obtained. The center pin produces a negative polarity reading (typically, -4.1 to -6.8 volts, depending upon degree of battery charge). The outer pin produces a positive polarity reading (typically 2.4 to 3.2 volts).

4. Add the two readings to find the total battery voltage. For example, readings of -4.43 and 2.36 volts means that battery voltage is 6.79 volts.

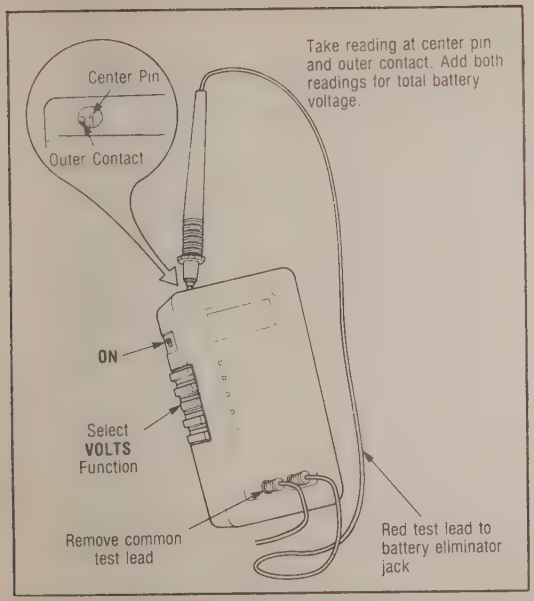

Fig. 4. Measuring battery voltage.

BATTERY REPLACEMENT (Refer to Fig. 5)

This instrument operates from a standard 9-volt transistor battery. An alkaline type is preferred for longer battery life, but a carbon-zinc type will also work. Select the battery from Table 4.

A battery must be installed when the meter is initially placed in service, and whenever the battery discharges to 6.5 volts. Remove a discharged battery immediately to prevent instrument damage from battery leakage. Remove the battery if the meter is to be placed in storage, or if it will be unused for several months.

1. Turn power switch OFF.
2. Loosen the two captive screws on the back of the meter and lift off the rear case. The battery compartment is now accessible.
3. Remove the battery from its compartment.
4. Unsnap the battery cable from the old battery and snap it onto the new one.
5. Place the new battery in the compartment, making sure it seats properly in the space provided before replacing the rear cover of the meter.

TYPE	NEDA	Burgess	Everready	Mallory	Panasonic	Ray-O-Vac
Carbon-Zinc	1604	2U6	216	—	006P	1604
Alkaline	1604A	—	522	MN1604	6AM6	—

Table 4. Battery selection table.

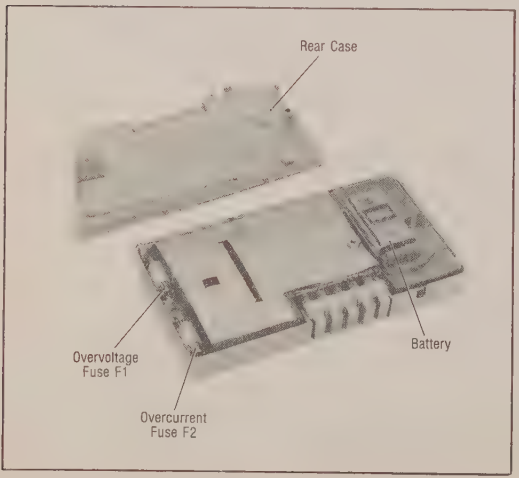

Fig. 5. Battery and fuse replacement.

FUSE REPLACEMENT (Refer to Fig. 5)

Fuse F1 protects the meter from overvoltage damage and fuse F2 protects the meter from overcurrent damage. If F1 is blown, all subsequent voltage readings are zero. If F2 is blown, all subsequent current readings are zero. Both fuses are located under the rear cover.

1. Disconnect the test leads from the equipment under test and turn the power switch OFF.

2. Loosen the two captive screws on the back of the meter and lift off the rear case. The fuses are now accessible.

3. Pull the fuse from the fuse clips by the fuse puller strap. The fuse fits very tightly into the clips, and it may be necessary to hold the circuit board in place while pulling.

4. Be sure the fuse puller is around the new fuse before inserting it. Use only a fuse of the correct voltage and current rating. F1 = 250 V, 1/16 A. F2 = 250 V, 2A.

5. Avoid repeating the condition that caused the overload.

TEST LEADS

Periodically examine the test leads to insure that the conductors are not intermittent and do not have broken strands. For safety, inspect insulation for any burns, cuts, or breaks. Do not use test leads if any wire strands are exposed. Also make sure that good contact pressure exists at the test lead jacks and that contact surfaces are free from dirt and corrosion.

SERVICING

WARNING

The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform servicing other than contained in the OPERATOR MAINTENANCE section unless you are qualified to do so.

CIRCUIT DESCRIPTION

Refer to block diagram, Fig. 6. The Model 2845 Autoranging Digital Multimeter operates by converting various types of inputs into a scaled dc voltage, which is then transformed into a digital readout by an A/D (analog-to-digital) converter.

A microcomputer controls automatic range selection (up-range, down-range, auto skip), range lock, KΩ and MΩ display, and continuity buzzer. The instrument is designed around a 4-bit microcomputer (IC7). This single 40-pin microcomputer chip includes the microprocessor, 1024 x 8 bit ROM (read only memory) for program storage, and 48 x 4 bit RAM (random access memory) for data storage. Range selection is made by sealed reed relays K1 thru K4. Relay activation, decimal point, and KΩ or MΩ symbol selection are under the control of the microcomputer. Table 5 summarizes the selections made for each range.

All voltage inputs are applied across a 10-megohm voltage divider network (resistor network RN-1). A decaded fraction of that voltage is selected by relay K1 to K4 and applied to A/D converter IC2. For an on-scale reading, this voltage is between −.1999 and +.1999 volt. For ac voltage, the input is first routed through ac/dc converter IC1 which rectifies the ac and produces a dc output which is calibrated to be proportional to the rms value of a sine wave ac voltage input.

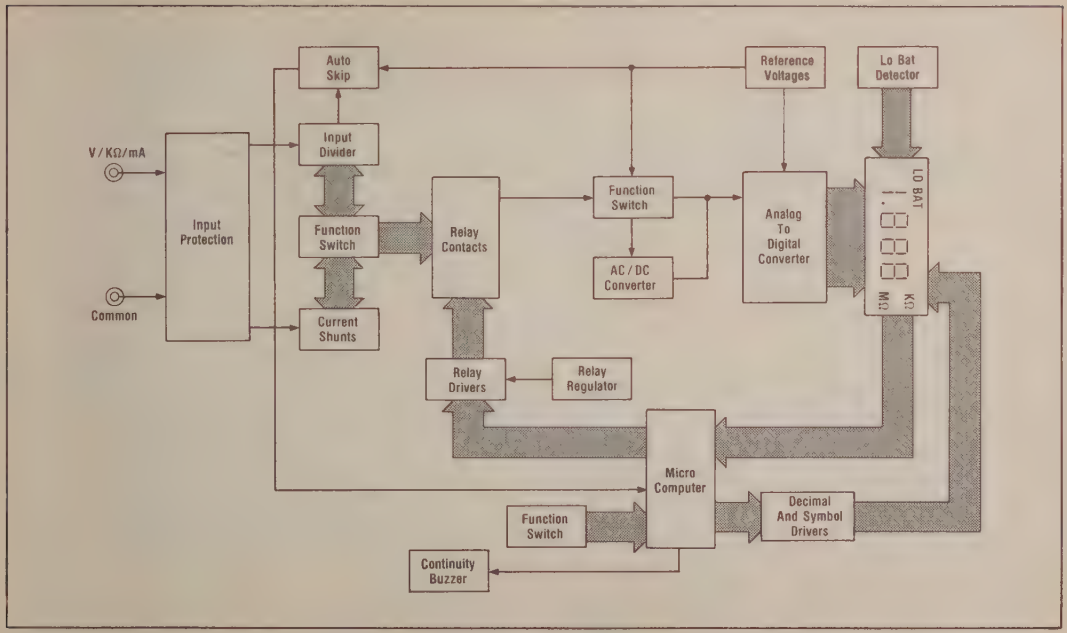

Fig. 6. Block diagram.

FUNCTION	RANGE	RELAY ENERGIZED	DECIMAL POINT ENABLED	ATTENUATION	SYMBOL ENABLED
VOLTS and MILLIAMPS	2 V/2 mA	K1	D.P. 1	1:1	—
	20 V/20 mA	K2	D.P. 2	10:1	—
	200 V/200 mA	K3	D.P. 3	100:1	—
	1000 V/2000 mA	K4	none	1000:1	—
OHMS	2 KΩ	K4	D.P. 1	—	KΩ
	20 KΩ	K3	D.P. 3	—	KΩ
	200 KΩ	K2	D.P. 3	—	KΩ
	2000 KΩ	K1	none	—	KΩ
	20 MΩ	none	D.P. 2	—	MΩ

Table 5. Relay, decimal point, and symbol selection summary.

Using the dual-slope integration technique, the A/D converter produces digital outputs which correspond to the analog value of its input. The digital signals are converted to numerical digits by the LCD display. The microcomputer is programmed to interpret certain of the digital signals from the A/D converter and automatically control range selection, decimal point placement, and the other functions under control of the microcomputer. Upon command, the microcomputer reads selected digital outputs of the A/D converter into its memory and compares each two consecutive sets of data. If two consecutive data readings are equal, the data is then stored in memory. This reading and comparing of data eliminates a potential source of instability. The digital information stored in memory is constantly being refreshed to insure accurate and reliable operation.

Resistance is measured by a ratiometric technique, where the unknown resistance is compared against a known resistance (selected segments of resistor network RN-1). A reference voltage is applied across the series circuit of the known and unknown resistances. The ratios of the two resistances is equal to the ratio of voltage drop across each. The voltages developed across the known and unknown resistance are both applied to the A/D converter, computed, and the value of the unknown resistance displayed.

For current measurements, the input is passed through one of four small shunt resistances selected by relay K1 to K4. The voltage drop produced across the selected shunt is directly proportional to the input current. This voltage is applied to the ac/dc converter for ac, or directly to the A/D converter for dc.

The function and mode switches determine which of the programs stored in ROM is to be executed. In the autoranging mode, the microcomputer produces an up-range command if the count is greater than 1999. The up-range command selects the next relay, shifts the decimal point, etc. as summarized in Table 5. A count of 179 or less produces a down-range command, with similar results in reverse. The up-range or down-range stepping continues until a count of 180 to 1999 results, or the highest or lowest range is reached. In the range lock mode, the up-range command initiates the overrange display. If range locked in the lowest resistance range, the down-range command (179 ohms or less) actuates the continuity buzzer.

The auto skip circuit is a threshold detector, sensing a point on the input voltage divider. It has the ability to detect positive or negative polarity input voltage that exceeds its threshold of approximately 25 volts. When its threshold is exceeded, it produces an "auto skip" command to the microcomputer. If range 1 is selected when this command is applied, it immediately skips to range 3 (200 V range). For example, touching the meter probe to 240 volts skips the meter to the 200 V range. It then up-ranges to the 1000 V range for an on-scale reading. This eliminates stepping through the 2 V and 20 V ranges and gives much faster settling time.

DISASSEMBLY (Refer to Fig. 7)

To access the circuit board for troubleshooting and repair, use the following procedure:

1. Remove rear case as described for battery or fuse replacement.

2. Lift the battery from its compartment and slide the battery wires out the slot, free from the component cover.

3. Remove the retaining nut from the rf shield and component cover.

4. Fold back the rf shield and lift off the component cover.

Most testing and troubleshooting can be performed without further disassembly. To completely remove the circuit board from the case, such as for parts replacement or to gain access to the solder side of the circuit board or the LCD display, proceed with the following steps:

5. Remove the nuts and lugs from the test lead jacks (component side of board).

6. The circuit board may now be folded out from the front case for access to both sides.

7. To completely detach the circuit board from the front case, unsolder the two wires that connect to the continuity buzzer (which is attached to the front case).

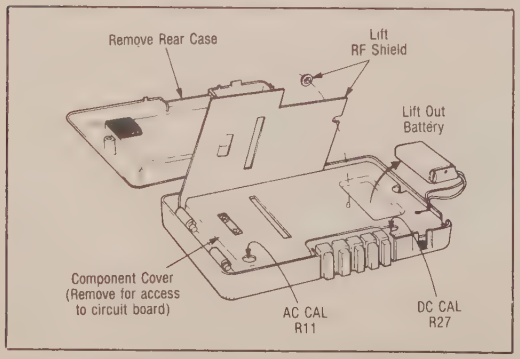

Fig. 7. Disassembly and location of calibration adjustment.

CALIBRATION

This instrument should not require calibration unless repairs have been made that change the factory calibration. Prior to calibration, the instrument should be checked for proper operation of all functions and for damage from physical abuse or excessive overloads.

Recalibration requires a low-impedance constant-voltage source (voltmeter calibrator) of 0.01% accuracy or better for dc and 0.1% or better for ac. Use of a voltage source with less accuracy reduces the accuracy of the meter proportionately. Adjustments *must* be performed in the sequence listed. Refer to Fig. 7 for location of calibration adjustments.

1. Remove the rear case from the meter, but leave the component cover in place. When ready to adjust the AC CAL potentiometer, R11, lift the rf shield for access to the adjustment.

2. Set up the meter for dc voltage measurement.

3. Apply +1.900 volts and adjust DC CAL potentiometer R27 for a reading of 1.900.

4. Set up the meter for ac voltage measurement.

5. Apply 1.900 volts rms low-distortion sine wave at any frequency from 50 Hz to 500 Hz and adjust AC CAL potentiometer R11 for a reading of 1.900.

TESTING AND TROUBLESHOOTING

Practically all circuits of the meter can be checked for proper operation in the OHMS function by measuring resistors of 1kΩ, 10kΩ, 100kΩ, and 1MΩ. Any voltage regulator, decimal point, display, A/D converter, microcomputer, range relay or relay driver, resistor network, or continuity buzzer problem will produce symptoms with these checks. Minus sign display can be checked by measuring the meter's battery voltage. A rough check of accuracy can be made by measuring the internal 0.1 volt reference voltage. If the problem is not found with these checks, a few additional tests will check all circuits not used in the previous checks. This includes measurement of an ac voltage, measurement of a voltage over 25 volts, operation from a low battery, and current measurement. These tests check the ac/dc converter, auto skip circuit, low battery detector, and current shunts respectively.

The following sequence of checks is recommended to determine whether all functions are operating properly, and is the recommended sequence for trouble isolation.

1. Select the AUTO and DC modes and the VOLTS function. Turn the power switch ON. The meter should display a .000 reading. Check the digits and decimal point for normal display.

2. Connect test leads across 1 kΩ resistor and select OHMS function. Check for display of KΩ symbol and display for correct value. If displayed value is 1.000 or higher, check for normal display of the first digit. If .999 or lower, check first digit in any subsequent step where it should appear.

3. Measure 10 kΩ resistor. Check for proper up-ranging, correct decimal point placement, and correct value displayed.

4. Measure 100 kΩ resistor. Again check for proper up-ranging, decimal point placement, and correct value displayed.

5. Measure 1 MΩ resistor. Again check for proper up-ranging, decimal point placement, and correct value displayed.

   Steps 2 thru 5 may be performed with a 1 megohm potentiometer, slowly increasing the measured resistance and noting that the meter up-ranges through the first four ranges.

6. Open test leads. Check for display of MΩ symbol and flashing of decimal points.

7. Short the test leads together and check for down-ranging.

8. With the test leads shorted and a display of .000 KΩ select the LOCK mode. Check for operation of the continuity buzzer.

9. Return to the AUTO mode and VOLTS function. If operation of the minus sign was not prevously noted, use the red test lead only and touch the probe tip to the center pin of the battery eliminator jack. Check for display of the minus sign.

10. An approximate check of accuracy may be made by touching the probe tip of the red test lead to the 0.1 volt reference voltage at the wiper of DC CAL potentiometer R27. A reading of approximately .100 volt should be displayed.

11. Select the AC mode and measure 120 volts ac line voltage. Check for auto skip (instant jumping of the decimal point when the probe tip is touched to the voltage) and correct value displayed.

12. If a weak battery is available (6.5 to 7.0 volts), install it and check LO BAT indication. An alternate method is to remove the battery and connect a well filtered dc power supply in place of the battery, carefully observing correct polarity. LO BAT threshold is typically in the 7.2 to 7.6 volt region.

13. Select the MILLIAMPS function and measure ac or dc current from a current source of 1 mA, 10 mA, 100 mA, and 1 A. Check that correct values are displayed. A current source may be fabricated from appropriate value and wattage resistors driven by a dc power supply of at least 1 amp capability or ac line voltage.

INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon B & K-Precision for this service, if it is ever needed. We maintain a network of B & K-Precision authorized service agencies for this purpose. To use this service, even if the meter is no longer under warranty, follow the instruction given in the WARRANTY SERVICE INSTRUCTIONS portion of this manual. There is a nominal charge for instruments out of warranty.

ADDITIONAL SERVICING INFORMATION

A complete service manual for this meter will soon be available. Preparation was under way while this manual was being printed, and it is probably now available. Requests for the service manual should be sent to the **B & K-Precision** Service Department address listed in the WARRANTY SERVICE INSTRUCTIONS. Be sure to specify Model 2845.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your **B & K-Precision** instruction manual for adjustments that may be applicable.

2. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest **B & K-Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its **B & K-Precision** product, and the component parts therof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B & K-Precision** service contractor or the factory service department, accompanied by proof of the date of purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, **B & K-Precision**, 6460 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B & K-Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B & K-Precision** Service Department, 6460 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

TEST INSTRUMENT SAFETY

(continued from inside front cover)

6. Do not operate instrument unless rear case is in place and fully closed.

7. Disconnect test leads from equipment under test and from the multimeter before replacing batteries or fuses, and before performing any servicing on the multimeter.

8. Use B & K-Precision Model BE-16 Battery Eliminator *only* for operating this instrument from ac power. Do not use a calculator type battery eliminator. Calculator type units do not provide the protection necessary for floating the common test lead up to 500 volts dc. A shock hazard and serious internal damage may result.

9. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if turned off.

10. Many equipments with 2-wire ac power cords are transformerless "hot chassis" powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized plug to prevent insertion the "wrong" way, a serious shock hazard exists if the chassis is touched. To make measurements in such equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The B & K-Precision Model TR-110 Isolation Transformer is suitable for most applications. To be on the safe side, treat all 2-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis. (However, the common jack of this multimeter is isolated from earth ground to permit it to be floated to a potential other than ground, up to 500 volts, for reference).

11. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

B+K PRECISION DYNASCAN CORPORATION

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